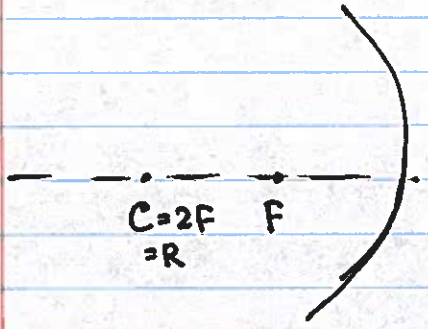
Converge mirror (same calculations work for a concave lens)



$f>0$

$$\frac{1}{d_i}+\frac{1}{d_o}=\frac{1}{f}$$

$d_o>0$

$$\frac{1}{d_i}=\frac{1}{f}-\frac{1}{d_o}=\frac{d_o-f}{d_o\cdot f}$$

$$d_i=\frac{d_o\cdot f}{d_o-f} \qquad M=\frac{h'}{h}=-\frac{d_i}{d_o}$$

$$M=-\frac{f}{d_o-f}$$

$d_o<f$ $\quad d_i<0 \rightarrow$ virtual image

$M>0 \rightarrow$ erect image

we always have $|d_o-f|<f \rightarrow M>1$

enlarged image

$d_o>f$ $\quad d_i>0 \rightarrow$ real & inverted image

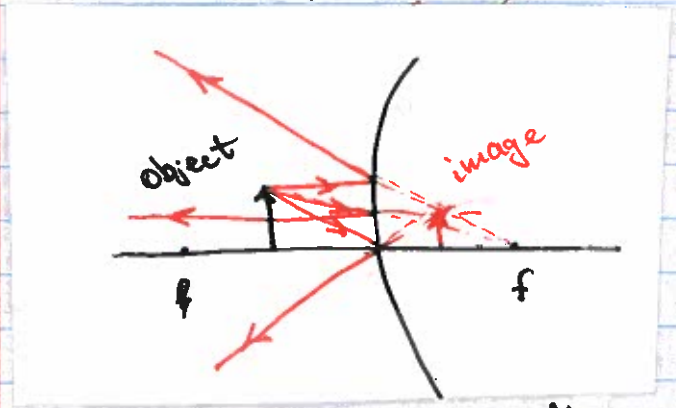
$$M=-\frac{f}{d_o-f} \qquad \frac{f}{d_o-f} \rightarrow d_o<2f \quad M\leq 1$$

~~diminished~~ enlarged

$d_o>2f \quad M<1$

diminished

Converge mirror (or convex lens)



$f<0$

$$\frac{1}{d_i}+\frac{1}{d_o}=-\frac{1}{|f|}$$

$$\frac{1}{d_i}=-\frac{1}{|f|}-\frac{1}{d_o}=-\frac{d_o+|f|}{d_o\cdot|f|}$$

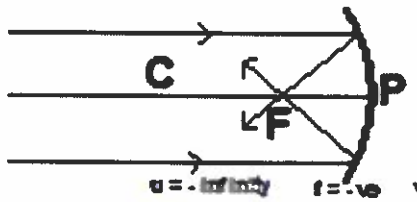
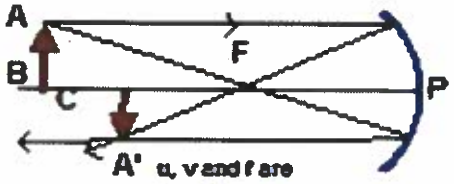
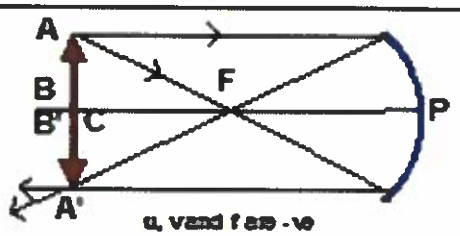
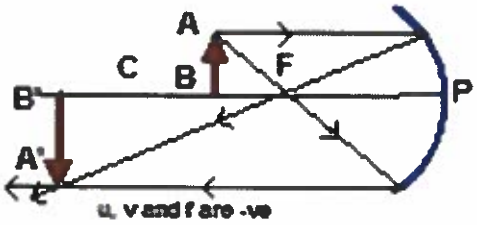
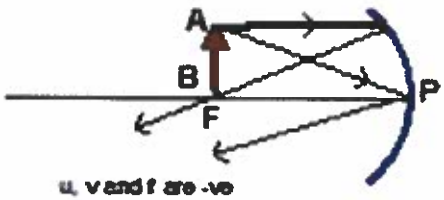
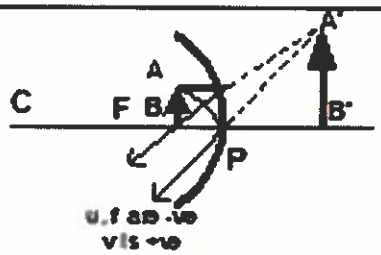
$$d_i=-\frac{d_o|f|}{d_o+|f|}$$ always virtual

$$M=-\frac{d_i}{d_o}=\frac{|f|}{d_o+|f|}<1$$

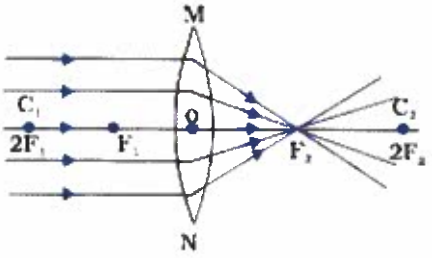
always positive

erect diminished image

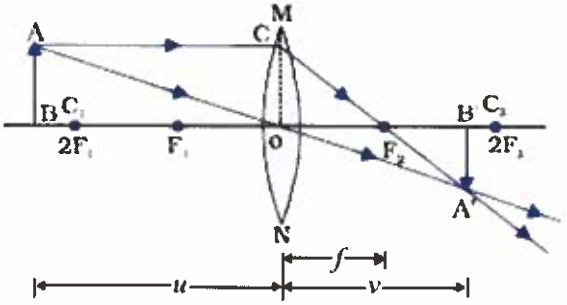
Image formed by Concave Mirror:-

Position of object	Position of image	Nature of image	Ray diagram
(i) At infinity	At focus	Real, Inverted, and diminished	
(ii) Beyond C	Between F and C	Real, Inverted and diminished	
(iii) At C	At C	Real, Inverted and same size	
(iv) Between F and C	Beyond C	Real, Inverted and enlarged	
(v) At F	At Infinity	Real, Inverted and highly enlarged	
(vi) Between F and P	Behind the mirror	Virtual, enlarged and erect image	

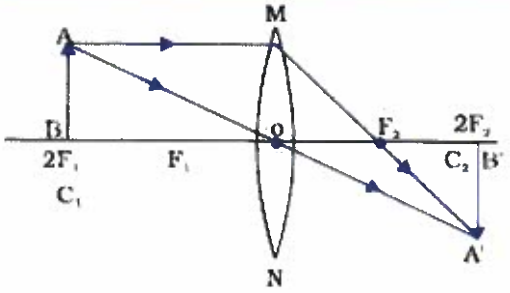
Here u = Distance of object
v = Distance of image



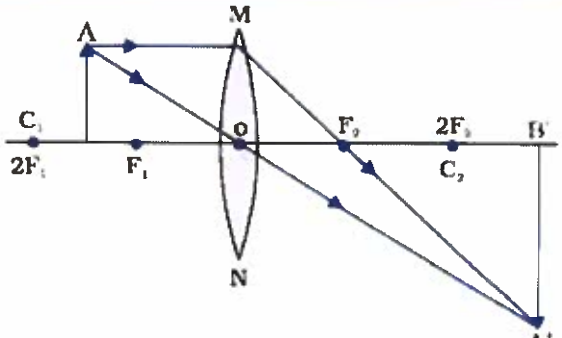
Case (i) Object at infinity



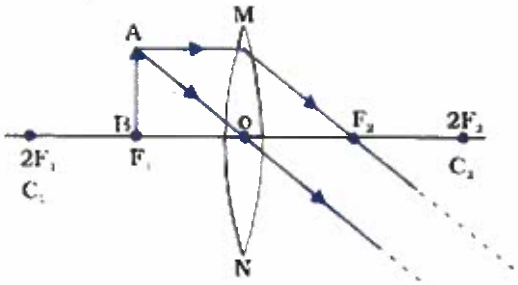
Case (ii) Object at beyond 2f



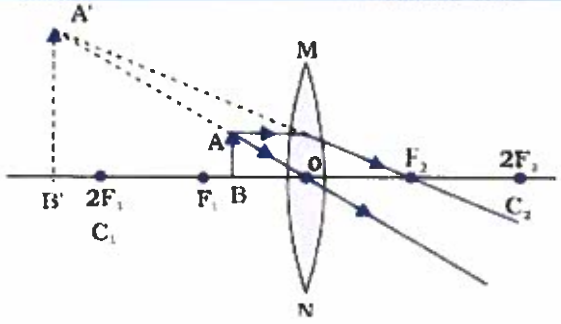
Case (iii) Object at 2f



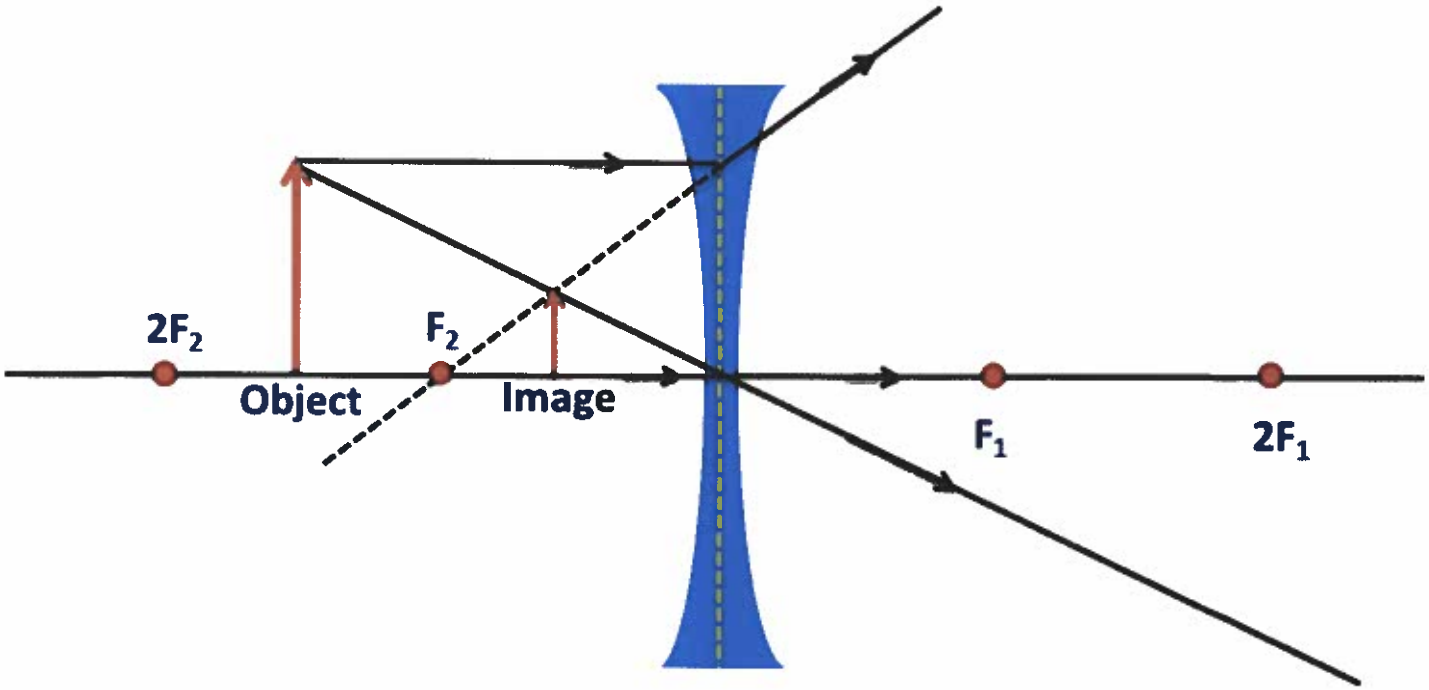
Case (iv) Object in between f and 2f



Case (v) Object at f



Case (vi) Object distance < f



Biconcave lens